ECO EYE-AI Powered Species Recognition System

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Abstract – **This paper presents an innovative project ECO EYE – AI powered species recognition system. A software application designed to facilitates species identification by classifying the image. Using the power of Artificial Intelligence & CNN, this system identifies the species in real-time through image recognition. On capturing the image of any plant or animal, the system will analyze the image; it will classify the image and retrieve the detailed information. The system offers detailed information about taxonomy at basic level, habitat, and population status. It also provides their uses and their role in nature. The system aims to serve as valuable resource for students, conservationist, and to those who are passionate to explore the nature and expanding the knowledge about plants and animals. This paper outlines the system's architecture, detailing the AI models and image classification techniques used for accurate identification. It further includes real world application to increase the knowledge of plants and animal species.**

Keywords: Species recognition, image classification, biodiversity, deep learning, nature exploration.

I. INTRODUCTION

In today's advance world, the rapid expansion of urban areas leads to deforestation which directly impact on biodiversity. Because of the deforestation the natural habitats of plants and animals leads to extinction of species. This ongoing disruption affects not only survival of species but also weakens the connection between humans and nature. With fewer opportunities for humans to interact with nature, the appreciation and understanding of plants and animals diminish. It affects the conservation efforts vital for the preserving biodiversity.

This paper seeks to address this issue, using advanced technology. The ECO EYE – AI powered species recognition system have the potential to bridge the gap between human knowledge about plants and animals by leveraging AI and image recognition technology. Using the capabilities of Deep Learning this project offer comprehensive features aimed to provide understanding of species. This paper is promising to offer the real-time information about identified species such as taxonomy, habitats, use, role in nature and population status. This real-time recognition tool is designed to be user friendly

and accessible to broad audience facilitating a deeper understanding of species diversity and its importance.

1.1 Project Aims and Objectives

- This paper aims to develop an AI driven species recognition system that provides quickly and accurately identify the species and give the information about it.
- Enable users to easily recognizing plants, animal species through AI powered image recognition technology.
- To provide detailed information about the species related to taxonomy, habitats, use ecological role, population status.
- To bridge the gap of human knowledge specially in urban areas toward nature.
- To conduct thorough review of existing technology, methodology to develop an AI powered recognition system that empowered users to get information about species.

1.2 System Objectives

- Provide Comprehensive Data: Deliver Information about identified species related to its taxonomy, habitats, contribution to nature, use, population status.
- Accurate species recognition: Using deep learning and CNN (convolution neural network) to identify species from an image with very low errors.
- Real time data access: Ensure that user receives instantaneous data upon capturing an image, making the system efficient.
- Contribute to Conservation: Enable user to track and monitor, species population trends especially for threatened, endangered species facilitating conservation efforts.

II. METHODOLOGY

ECO EYE – AI powered species recognition system based on deep learning. This section describes the proposed methodology in details as shown in Figure 1.
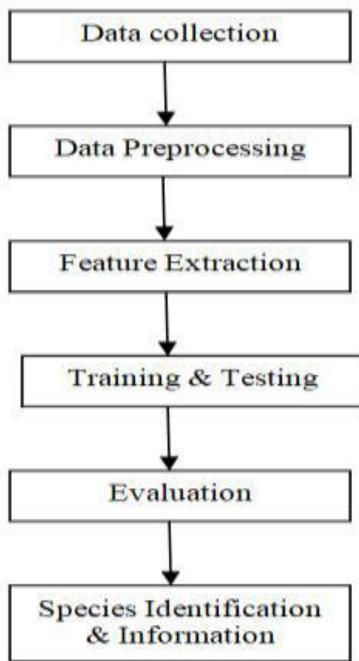
Figure 1: Model development Process

2.1 Data collection

The data used in this project is sourced from publicly available platforms. A significant portion of the dataset is obtained from Kaggle, an open-source platform providing a variety of datasets. The data primarily consists of images of plants and animals, which are used for sample testing and development purposes. Additionally, some of the images are collected from Google and stored in CSV files. This initial dataset is designed to provide a diverse set of sample images, with plans to further expand and enhance the dataset in the future for improved system performance.

2.2 Data preprocessing

Data preprocessing is crucial to focus on region of interest within the image to ensure the accurate recognition. During the preprocessing data classified into 20 classes, consisting of 10 plant and 10 animal species. Label encoding is applied to categorize the images according to these classes. Each image is resized to 64x64 pixels to standardize the dimensions, ensuring consistency across the dataset. Additionally, data augmentation techniques are employed to enhance feature extraction and improve accuracy. This preprocessing step significantly improves the reliability and performance of the classifier.

2.3 Feature extraction

In feature extraction it selects the most important features require for the development of model. For feature extraction we used CNN (Convolution Neural Network) particularly

effective for image classification extracting important subset of relevant features. In CNN convolution layer scan the images and extract features like shapes, textures, colors. The Activation Function Relu (Rectified Linear Unit) applied to introduce non linearity and to learn complex patterns. Maxpooling is applied to reduce spatial dimension of the features maps to 2x2 dimension helps to reduce complexity in pooling layer. The final output from the CNNs feature extraction layer includes the set of high-level feature map represent essential visual properties of species in image.

2.4 Training and Testing

For the better evaluation of model, dataset is split into 70:15:15 ratio where 70% dataset for training, 15% for validation and 15% used for testing the model. The model is compiled with adam optimizer, categorical_cross_entropy as the loss function, and accuracy as the evaluation metric. To prevent overfitting by monitoring validation loss and restoring the best weight, the model is trained with 50 epochs and early stopping. The 15% validation dataset used to monitor the model performance on unseen data during training helps to prevent overfitting. During validation, performance of model is closely monitored using accuracy and loss curves to ensure generalization.

2.5 Evaluation

The evaluation of the model is performed using key metrics on dataset. During evaluation both quantitative metrics and qualitative observation were employed to ensure robust species identification. As the model was trained with 70% of dataset, validated with 15%, and tested with 15% of dataset. The accuracy of the model is shown in Fig. 2.
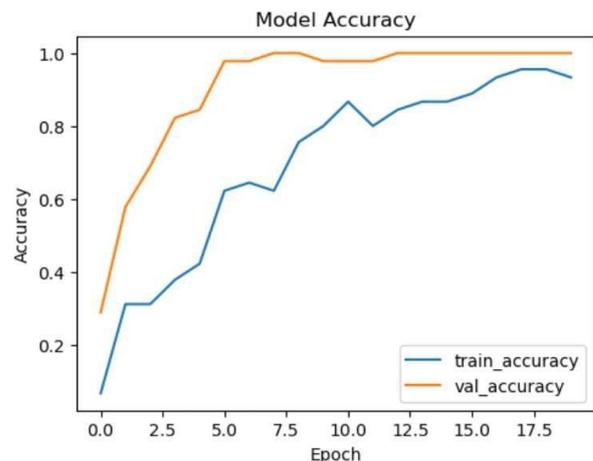

Figure 2: Accuracy of the model

The training and validation process was monitored over 50 epochs which shows the good improvement with low validation loss as shown in Fig. 3.
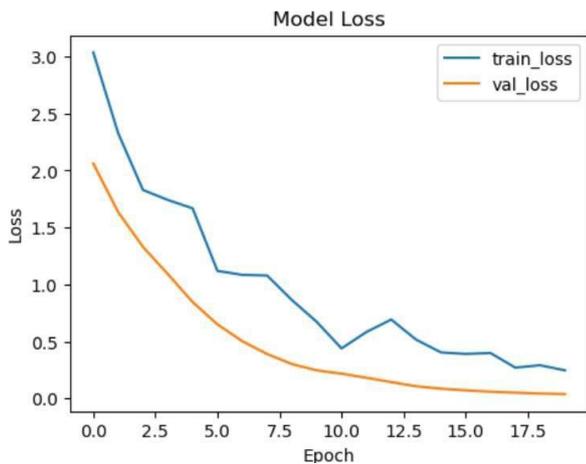
Figure 3: Loss in predicting the model

Sometimes misclassification occurred mostly in species because of the similar visual characteristics. This suggests that expanding the dataset and adding more detailed features to enhance system's accuracy in future.

2.6 API integration

To provide the information about identified images of plants and animals, various APIs are utilized. Delivering detailed information about the identified species is a key feature of this paper. The APIs access data about taxonomy, habitat, uses, contributions to nature, and population status. These publicly available APIs are chosen specifically for enhancing the system's capability to inform users about species in a comprehensive manner.

2.7 User Interface

We aimed to create a simple and user-friendly interface for the ECO EYE application to provide a smooth experience. The following technologies were used in the development of the application:

- HTML (Hypertext Markup Language): Used for designing the frontend of the application.
- CSS (Cascading Style Sheets): Employed to style the application and enhance its visual appeal.
- Django: A high-level Python framework utilized for database management and authentication, ensuring security and accelerating application development.

Additionally, various Python libraries were incorporated as per need to optimize the application's performance.

III. RESULTS

The model was tested on set of plant and animal images. The results demonstrate the model's effectiveness in identifying accurate species and providing relevant

information about their taxonomy, habitats, uses, population status, and contribution to nature Fig. 4.
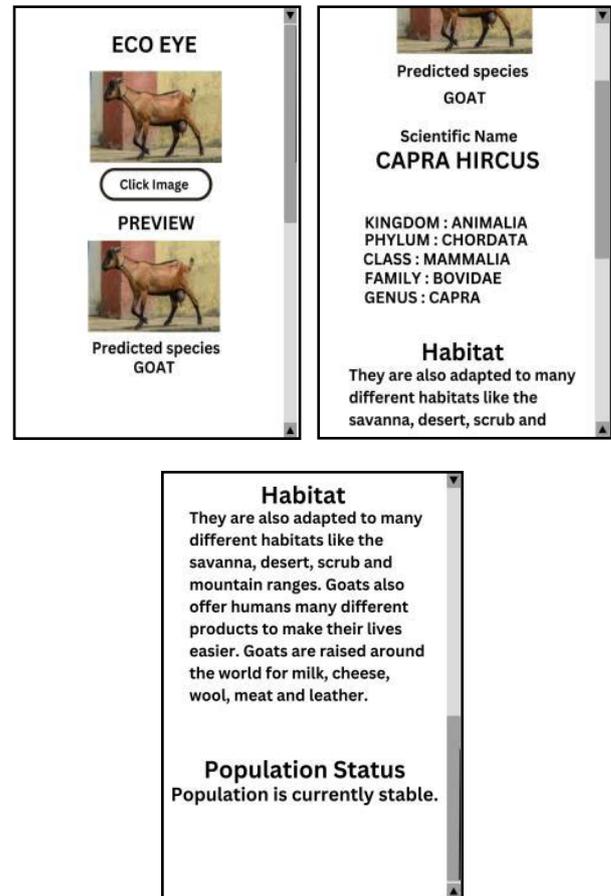

Figure 4: Expected output of ECO EYE

While the results are promising, the future improvement of this model include expanding the dataset to cover more species, improving classification of visually similar species, and enhancing the system's performance in challenging conditions like low-light environments.

IV. CONCLUSION

This paper presents an innovative and comprehensive approach to recognize the species and provides the information about their taxonomy, habitats, uses, role in nature, and population status using cutting-edge AI technology. By offering a seamless and accessible platform, ECO EYE has the potential to benefit to users who are passionate about exploring nature, enabling users to discover and learn about new species every day. Currently, this model achieves better accuracy on the test dataset, indicating its promise as a reliable technology. The model has demonstrated good recognition accuracy and is worthy of further study and optimization. We aim to continuously expand the dataset to include a wider variety of species from diverse ecosystems.

This enhancement will ensure that the project becomes more powerful and reliable for large-scale species recognition.

V. FUTURE SCOPE

- Increase dataset and accuracy: On expanding species dataset in future it can improve the accuracy, will make strong resource for study about species to researchers, students and conservation.
- Integration with Drone: On integrating with drone this project can be helpful to explore dense forests, hard to reach areas, mountain ranges, to identify species in those areas and provide valuable information.
- Citizen Science: This platform could be open for contribution from public, especially tribes who have the knowledge about species and uploading image of such species which could be valuable for nature studies.
- Augmented Reality and Virtual Exploration: Integrating AR could offer immersive educational experience, allowing user to explore species and biodiversity interactively on natural trails and parks.
- Global Collaboration: On collaborating with international species datasets, can contribute to global biodiversity monitoring efforts.

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